



Contribution ID: 13

Type: **not specified**

High-Resolution Spectroscopy of Muonic Lithium - First Steps and Prospects of the QUARTET Experiment

Thursday 29 August 2024 15:15 (25 minutes)

Precise measurements of absolute nuclear charge radii are crucial ingredients for QED tests and are valuable benchmarks for modern nuclear structure theory [1]. Muonic atom spectroscopy is well known as an ideal method to accurately determine the root-mean-square (RMS) radii of the nuclear charge density distribution. By measurements of the 2p-1s transitions of muonic atoms, this technique has already provided precise measurements for the very light ($Z < 3$) as well as heavier nuclei ($Z > 10$) [2]. However, a gap for muonic atoms from lithium to neon remains due to the inaccessibility of the relevant energy range (~ 20 -200 keV) via laser spectroscopy and the insufficient resolution of conventional solid-state detectors for precision measurements. To address this gap, the QUARTET collaboration employs cryogenic metallic magnetic calorimeters (MMCs), which combine broad-band spectra with record resolving power, to perform spectroscopy of light muonic atoms and to refine the nuclear charge radii of light nuclei from lithium to neon [3].

In October 2023, QUARTET's first test beam time took place at the Paul Scherrer Institute (PSI), where the feasibility of this approach has been demonstrated successfully. This contribution presents the status and plans of the experiment and shows the first broad-band high-resolution spectra of muonic lithium obtained with an MMC.

References:

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Session Classification: Parallel I